J. Environ. Nanotechnol.
Volume 8, No.3(2019) pp. 30-33
ISSN (Print): 2279-0748
ISSN (Online): 2319-5541
doi:10.13074/jent.2019.09.193373

Synthesis and Characterization of Poly Ortho Toluidine Doped with Commercial TiO_2 Nanoparticle

V. Gayathri[1], R. Balan[2*]

[1,*2]*Department of Physics, Chikkanna Government Arts College, Trippur, TN, India.*

Received: 21.08.2019   Accepted: 25.09.2019

Abstract

The aim of this work was to study the changed properties of commercial TiO_2 with conducting polymer such as poly ortho toluidine were synthesized by chemical oxidative polymerization. The metastable anatase phase of TiO_2 and POT+ TiO_2 composites were characterized by using X-Ray Diffraction analysis (XRD), Scanning Electron Microscopy (SEM-EDX) and Fourier Infrared Spectroscopy (FTIR). The bandgap of samples find out by UV-Visible spectroscopy.

Keywords: *Commercial TiO_2, FT-IR, Polyortho toluidine (POT), SRD, UV-Vis.*

1. INTRODUCTION

Conducting polymer such as poly aniline is considered to be unique due to its excellent electrical and optical properties. Poly aniline have been used in variety of applications such as corrosion protection, catalysis, sensors because of its non-redox doping, good environmental and thermal stability, high conductivity and economic feasibility. The properties of conducting polymer composites depends upon the doping concentration of nanoparticles (Tieli Zhou *et al.* 2015; Kiran Kumari *et al.* 2011). Among conducting polymers poly ortho toluidine is highly attracted and it has better solubility and higher processability by steric hinderence π-electron effects (Gigliola Lusvardi *et al.* 2017). TiO_2 is a semi conducting nanoparticles play an important role in wide range of applications due to its good photo catalytic activity and used for large scale production, cosmetics and air purification. The three types of crystallographic structures of TiO_2 are anatase, rutile and brookite. Among all these phases rutile is the most stable one where anatase and brookite corresponds to metastable and unstable states (Bin Wang *et al.* 2015).

The aim of this work was to study the changed properties of TiO_2 due to the presence of poly ortho toluidine in the composites. Chemical oxidative polymerization method is used to synthesize poly ortho toluidine. Here we report the synthesis as well as structural and optical properties of poly ortho toluidine doped with TiO_2 nanoparticles. The functional groups of materials were determined by Fourier infra red spectroscopy (FTIR).The functional groups of samples were examined by FTIR spectroscopy. The morphology, structural and band gap of TiO_2 and Poly ortho toluidine/TiO_2 composites can be carried out by SEM-EDX, XRD and UV spectroscopy.

2. EXPERIMENTAL DETAILS

2.1 Materials & method

O-toluidine (99% AR grade, Lobal chemie laboratory reagents & fine chemicals), H_2SO_4, Ammonium peroxo disulfate (>98%, Merck), Commercial TiO_2 (98%,Fisher scientific), Millipore – Q water were used as received.

Poly ortho toluidine- TiO_2 composites has been synthesized by chemical oxidative polymerisation at room temperature. In this process, an appropriate amount of size reduced TiO_2 is dispersed in 0.2 M of H_2SO_4 by ultrasonication. After that this dispersed TiO_2 solution is added slowly to 0.1 M aqueous solution of O-toluidine with continuous stirring for 30 minutes.0.1 M aqueous solution of ammonium peroxo disulfate was added dropwise to polymerisation bath to initiate the polymerization and the solution was left for 4 hr with continuous stirring. Later the solution was allowed to kept for overnight. The resultant precipitate was filtered and washed several times with acetone followed by

* ***R. Balan***
email:balanphy@yahoo.co.in

water and to be dried at 80 °C in an oven. Finally dark green colour powder form of POT/ TiO_2 composite can be obtained.

3. MATERIAL CHARACTERIZATION

X-ray diffraction data of samples were recorded using XPERT diffractometer. The surface morphology and elemental compositions have been investigated by scanning electron microscopy (SEM) and energy dispersive X-ray spectroscopy (EDX).Absorption spectra of anatase phase of TiO_2 and composites were recorded by using UV-Visible spectrometer (DRS), Analytek Jena, Germany. The functional groups of samples were found by ATR-FTIR, Bruker, Germany.

4. RESULTS & DISCUSSION

4.1 X-ray diffraction analysis

The XRD characteristic peaks at 25°,31°,37° in fig.1a represents the anatase phase of TiO_2 corresponding to the (101) (004) (200) planes. The XRD spectra of POT+ TiO_2 in fig.1b is similar to that of pure TiO_2 shows that the crystalline phase of TiO_2 did not change by poly ortho toluidine. The only difference is that the intensity of diffraction peaks of POT+ TiO_2 composites was slightly lesser than that of pure TiO_2 due to the amorphous nature of POT in the composites.

4.2 Morphological analysis

The morphology of pure TiO_2 and POT+ TiO_2 were examined by scanning electron microscopy.Fig.2 (a) shows the SEM micrographs of TiO_2 nanoparticles are spherical in shape where fig.2 (b) reveals that flaky like feature with globular structure of POT interlinked with TiO_2 nanoparticles which confirm the formation of composites. Fig.3 (a & b) shows the elements corresponds to TiO_2 and POT+ TiO_2 composites.

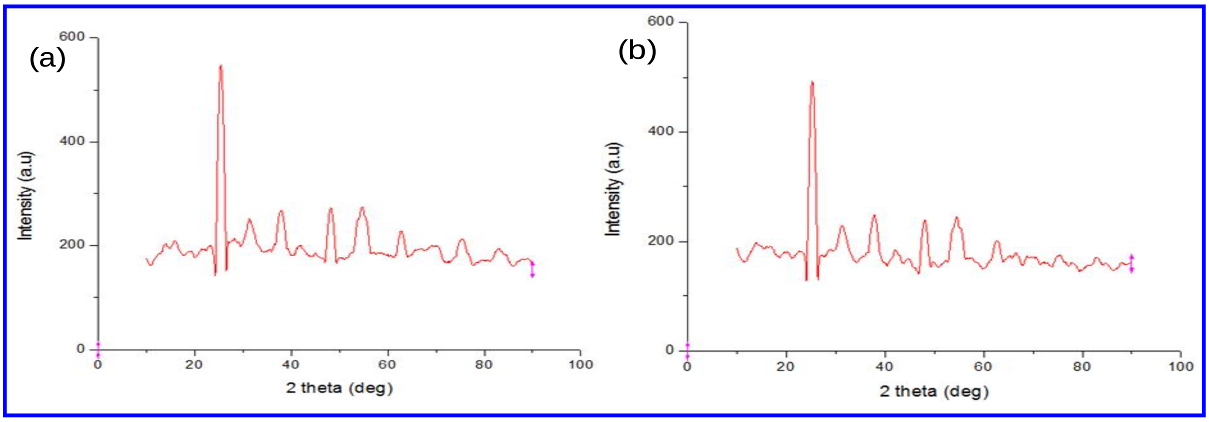

Fig. 1: XRD of (a) TiO_2 nanoparticle (b) POT + TiO_2 composites

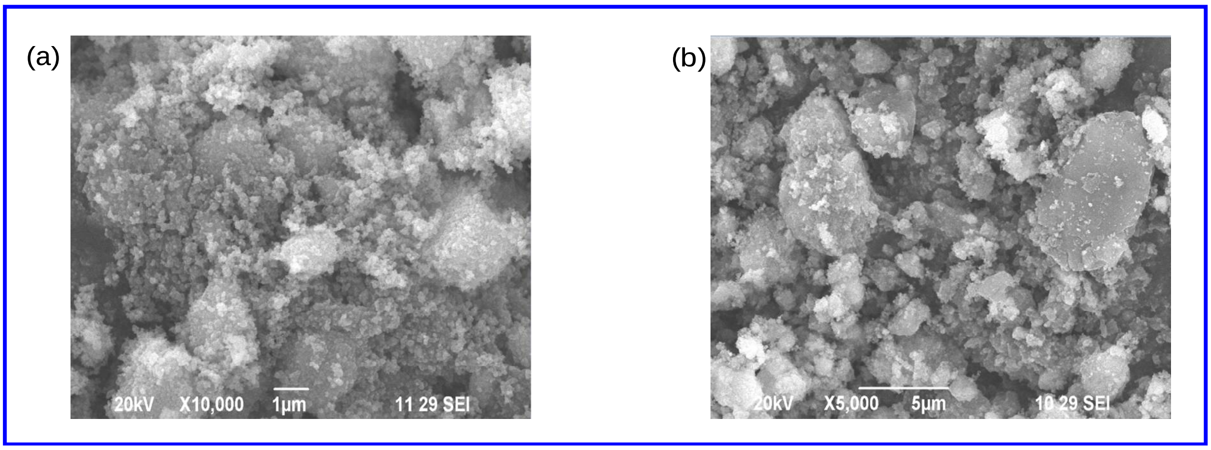

Fig. 2: SEM images of (a) TiO_2 nanoparticle (b) POT + TiO_2 composites

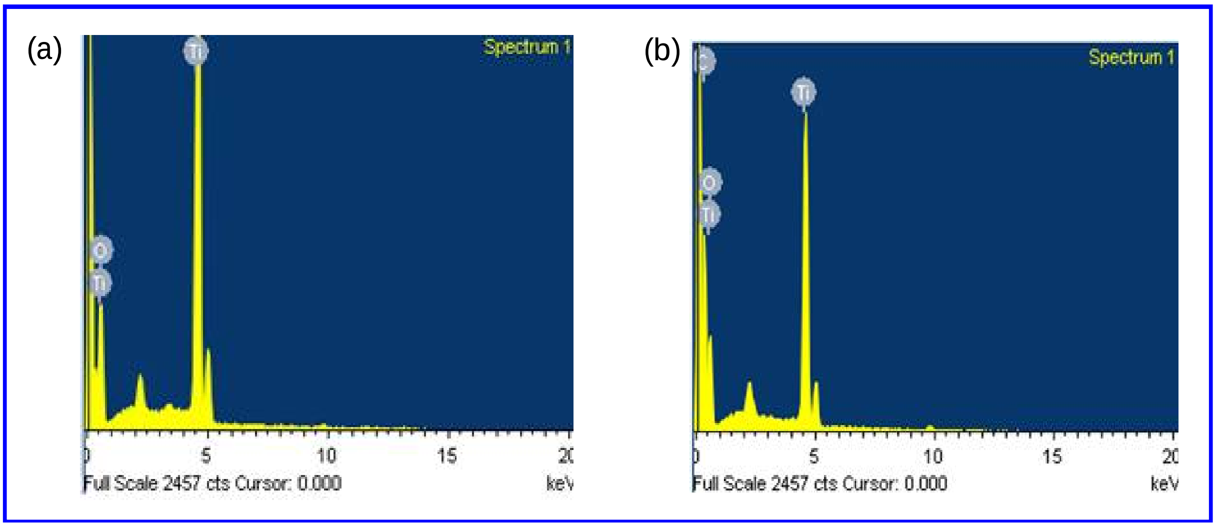

Fig. 3: EDX spectra of (a) TiO_2 nanoparticle (b) POT + TiO_2 composites

4.3 UV Vis Spectroscopy

In fig.4 (a & b) the absorbance of TiO_2 and POT+ TiO_2 composites is about 344 nm and 334 nm respectively. The absorbance of composites is slightly shifted to lower wavelength indicating the dispersion of TiO_2 in the composites. The band gap of pure TiO_2 and POT+ TiO_2 can be calculated by using the formula E=hγ. The band gap value of composites is 3.7 eV which is greater than pure TiO_2 (3.6 eV).

4.4 FOURIER INFRA RED SPECTROSCOPY

In Fig.5 (a & b) shows the FTIR spectra of pure TiO_2 and POT+ TiO_2 composites. It can be seen from fig.3(a),the characteristic peaks at 3749 cm^{-1} and 604 cm^{-1} indicate the Ti-O-Ti and O-H stretching frequencies (Asha *et al.* 2014). The intensity of characteristic peaks corresponds to composites is somewhat similar to that of pure TiO_2 with additional peaks at 3619 cm^{-1} corresponds to the N-H stretching of an aromatic amine and it confirms the formation of POT in the composites (Borriello *et al.* 2011). The peaks observed at 1494 cm^{-1} in composites corresponds to C-N stretching vibrations of quinoid and benzenoid rings (Canon Uchoyuk *et al.* 2012).

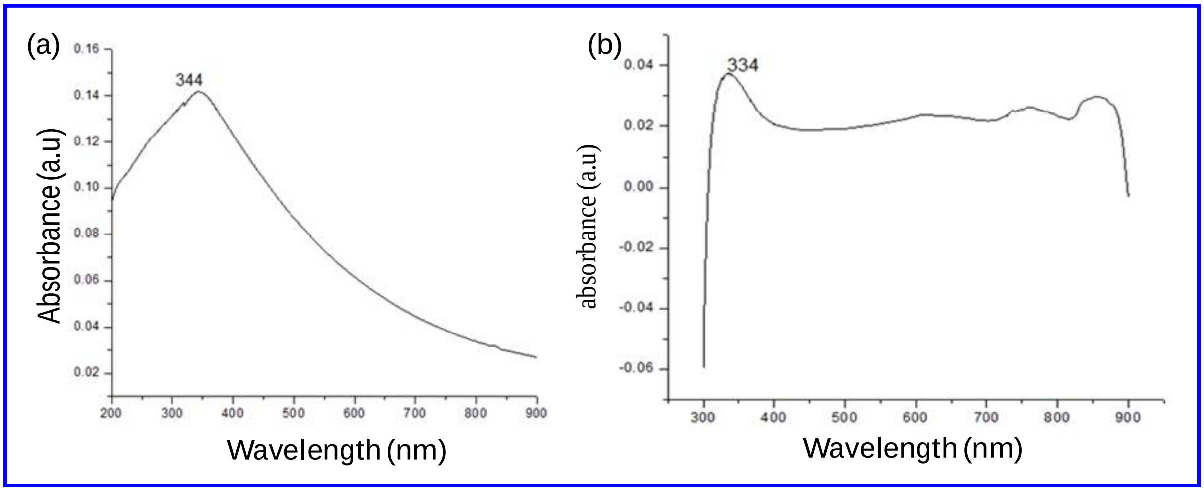

Fig. 4: UV –Visible spectra of (a) TiO_2 nanoparticle (b) POT + TiO_2 composites

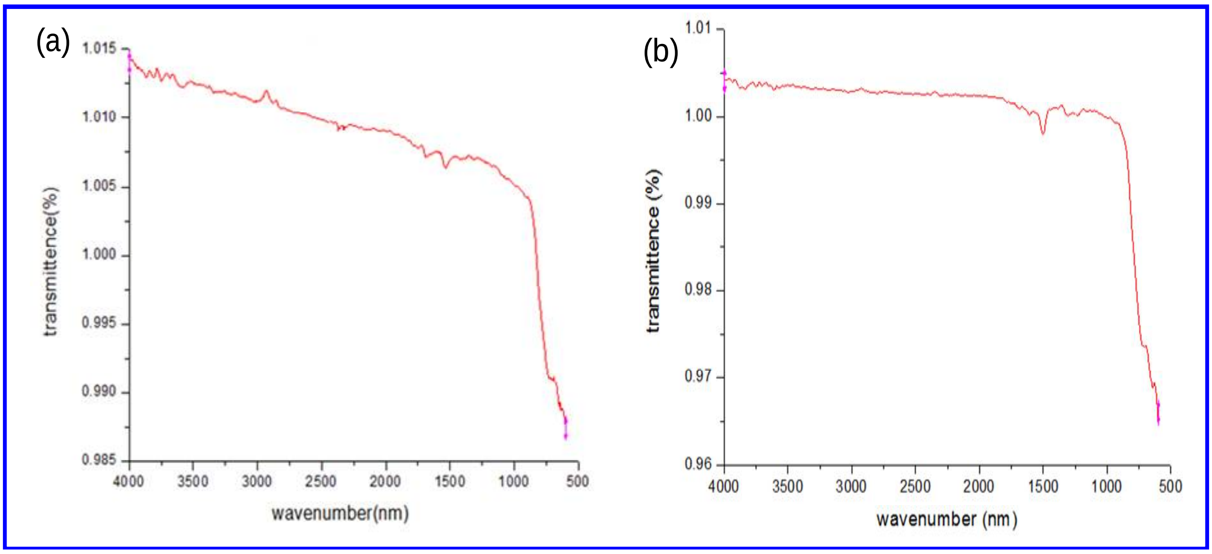

Fig. 5: FT-IR spectra of (a) TiO_2 nanoparticle (b) POT + TiO_2 composites

5. CONCLUSION

The changed properties of TiO_2 due to the presence of poly ortho toluidine were synthesized by chemical oxidative polymerization method. XRD studies show that the crystalline structure of anatase TiO_2 with amorphous nature of poly ortho toluidine, which confirms the formation of composites with lesser intensity. The functional groups and spherical morphology of TiO_2 interlinked with poly ortho toluidine was examined by FT-IR and SEM-EDX. UV-Visible spectroscopic results show that POT+ TiO_2 composites exhibit higher band gap when compared to pure TiO_2.

REFERENCES

Asha, Sneh Lata Goyal, Kumar. D, Shyam Kumar and Kishore.Nn., Synthesis and characterization of polyaniline/TiO_2 composites, Indian Journal of Pure and Applied Physics, 52(2), 341-347 (2014).

Bin Wang, Hongji Qi, Hu wang,Yanyan Cui, Jiaoling Zhao, Jialu Guo, Yun Cui, Youchen Liu, Kui Yi and Jiando Shao, Morphology, structure and optical properties in TiO_2 nanostructured films annealed at various temperatures, Optical Materials Express, 5(6), 1410-1418 (2015). doi:10.1364/OME.5.001410

Borriello, A., Guarino, V., Schiavo, L., Alvarez Perez, M. A. and Ambrosio, L., Optimizing PANi doped electroactive substrates as patches for the regeneration of cardiac muscle, J. Mater. Sci. Mater. Med., 22(4), 1053-1062(2011). doi:10.1007/s10856-011-4259-x

Canon Uchoyuk, Meral Karakisla and Mehmet Sacak., Preparation of Poly (o-toluidine) / Polyacrylonitrile composite fibers using CrO_3, Indian Journal of Fiber and Textile Research, 37(2), 120-126(2012).

Gigliola Lusvardi, Corrado Barani, Federica Giubertoni, Giulia paganelli.: Synthesis and characterization of TiO_2 nanoparticles for the reduction of water pollutants, Materials, 10(10), 1208-1218(2017). doi:10.3390/ma10101208

Kiran Kumari, Vazid Ali, Gita Rani, Sushil Kumar, Lakshmi, G. V. B. S. and Zolfequar, M., DC conductivity and spectroscopic characterization of poly (o-toluidine) doped with binary dopant $ZrOCl_2$/AgI, Materials Sciences and Application, 2(8), 1049-1057(2011). doi:10.4236/msa.2011.28142

Tieli Zhou, Xiuhong Xie, Jianyan Cai, Liying Yin and Weidong Ruan, Preparation of Poly (o-toluidine) / TiO_2 nanocomposite films and application for humidity sensing, Polym.Bull., 73(3), 621-630(2015). doi:10.1007/s00289-015-1509-y